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ABSTRACT

The Biomedical Interdisciplinary Curriculum Project (BICP) is a two-year interdisciplinary precollege curriculum designed to prepare high school students for entry into college and vocational programs leading to a career in the health field. Composed of three separate yet interrelated courses with interdisciplinary relationships between mathematics, science and social science, the curriculum package is designed with an emphasis on science, a great part of which is health content, which has been selectively integrated into the mathematics and social science courses. This manual is designed to assist high school personnel in implementing the BICP. It presents an overview of BICP, providing the rationale, objectives, format, and content of the curriculum package. Tables list unit titles and content for the courses of Biomedical Mathematics, Biomedical Science, and Biomedical Social Science. The Biomedical Instrument Package (BIP), Biomedical Practicum, and guidelines for the biomedical teaching team, teacher, student, and administration, are generally described. Curriculum and budget approval, implementation costs, course scheduling, and preservice and inservice training are also discussed. (CS)

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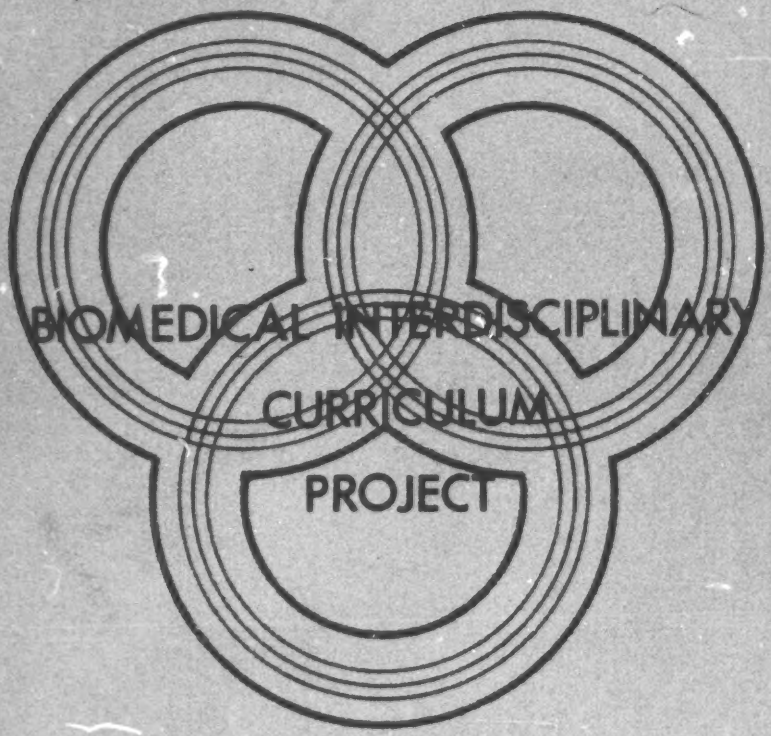

IMPLEMENTATION MANUAL
for
HIGH SCHOOL PERSONNEL

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SE 031 461

IMPLEMENTATION MANUAL
FOR HIGH SCHOOL PERSONNEL

THE BIOMEDICAL INTERDISCIPLINARY CURRICULUM PROJECT

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IMPLEMENTATION OF THE
BIOMEDICAL INTERDISCIPLINARY CURRICULUM

The purpose of this manual is to assist high school personnel in implementing the Biomedical Interdisciplinary Curriculum. Its contents reflect the implementation experiences of many past and present biomedical teachers and BICP staff. The ease with which high school personnel have been able to implement the curriculum, with minimal project assistance, is due in part to the comprehensive instructors manuals provided for each of the biomedical courses--science, mathematics and social science.

The following overview of the Biomedical Interdisciplinary Curriculum, including project developed hardware and the student practicum, will provide the reader with the rationale, objectives, format and content of the curriculum package. Guidelines for developing a biomedical teaching team are presented next. In the sections on teacher and student selection, criteria are suggested for recruiting biomedical teachers and students. The balance of the manual is devoted to aiding the administrator in the areas of budget, course scheduling and teacher preparation for implementing the curriculum.

THE BIOMEDICAL INTERDISCIPLINARY CURRICULUM

Health encompasses a dynamic network of interrelated life systems. It can be defined and promoted only by integrating the views of many disciplines. The World Health Organization has redefined health as "not merely the absence of disease and infirmity, but the complete social, physical and mental well-being of the individual." At the time this new definition was adopted, optimal health appeared attainable through the contributions of science and technology. Unfortunately, this hope was premature. Rather than approaching "complete... well-being" we are currently experiencing a resurgence of several diseases of the past and adding to a growing list of new health problems. Many current health problems result from inappropriate applications of science and technology; others are consequences of social conditions, such as the rapidity of culture change to which we are now trying desperately to adjust. Moreover, the measures needed to both ameliorate long-standing health problems and prevent new ones are often preempted by conflicting values and actions providing short-term material gains at the expense of long-term human loss.

We all have a vote in shaping the future world. If that world is to be healthy, we must equip our future decision-makers to foresee the impact of applied science and technology on humanity and to realize the limitations of science and technology as sources of solutions for human problems. A commitment to values which support an interdisciplinary view of man and his environment is essential to attaining an ecological balance and to achieving optimal levels of health. The Biomedical Interdisciplinary Curriculum Project (BICP) evolved as a response to the need for a holistic view of health, the critical shortage of health-manpower, the growing requirement for health information, and the necessity to bridge the conflict between technology and humanity. The BICP is dedicated to preparing future health professionals and decision-makers to successfully encounter these and other kaleidoscopic issues critical to improving the quality of life through better health. This undertaking involves the development

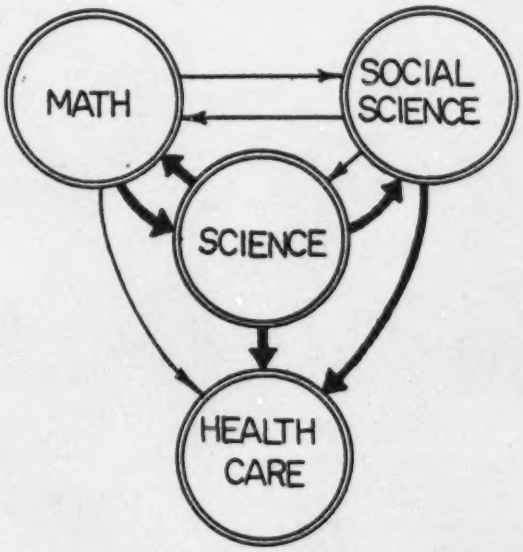
and dissemination of a two-year interdisciplinary precollege curriculum to prepare high school students for entry into college and vocational programs leading to a career in the health field.

THE CURRICULUM

The curriculum package is composed of three separate yet interrelated courses with interdisciplinary characteristics within and between them. By design, the interdisciplinary relationships between mathematics, science and social science are dissimilar in emphasis (see "The BICP Model," opposite).

The science curriculum provides a reservoir of health content which has been selectively integrated into the mathematics and social science courses. The interdisciplinary contributions flow primarily from mathematics to science and from science to social science on a prevailing current of health problems.

The various fields of study contained within each separate course are indicated in Tables I, III and V. The predominant area of study in the mathematics curriculum is linear functions with trigonometric functions a close second (see Table II).



THE BICP MODEL

The Biomedical Curriculum assumes four class periods each day for two school years. Biomedical science occupies two class periods, whereas mathematics and social science each meet for one class period daily. Variations of this theme are possible. Some school administrators have elected to offer one and a half years of social science to enable their students to take other courses. Some educators have combined the mathematics and science courses in a three-period block and used a team-teaching approach.

BIOMEDICAL MATHEMATICS

The uniqueness of the biomedical mathematics course lies less in the concepts presented than in its approach to the subject matter. Traditional mathematical skills are developed throughout the curriculum by means of specific biomedical applications. Lesson sequences both parallel the content of the science course and maintain their own integrity in the development of mathematical concepts, progressing from the simple to the conplex. Course content is similar to the standard eleventh- and twelfth-grade college preparatory mathematics courses in its coverage of linear, quadratic, exponential and trigonometric functions but is not as comprehensive in its coverage. Content areas such as error analysis and statistics not traditionally taught in high school mathematics programs are also included. Traditional mathematics problems seldom encountered outside the classroom (e.g., "If Jay is twice as old as Jon, but only half as...") are replaced by practical health problems. Students are not only more receptive to learning new mathematical techniques for which there are practical applications but their ability to recall them is equally improved.

TABLE I

UNIT TITLES OF BIOMEDICAL MATHEMATICS

Unit	Unit Title
YEAR ONE	
I	Measurement, Linear Functions and Dimensional Algebra
II	Uncertainty, Vectors and Chi Square
III	Theoretical and Applied Quadratics
YEAR TWO	
IV	Symbolic Logic
V	Trigonometry
VI	The Binomial Theorem and Genetics
VII	Introduction to Differential Calculus
VIII	Exponents and Logarithms

TABLE II

PERCENT OF SUBJECT CONTENT
IN BIOMEDICAL MATHEMATICS

Subject	Percent
Linear functions	17%
Trigonometric functions	12%
Statistics	11%
Quadratic functions	10%
Binomial theorem	9%
Exponents and logarithms	8%
Vectors	8%
Measurement and error	8%
Differential Calculus	7%
Complex numbers	3%
Symbolic logic	3%
Miscellaneous	3%

The biomedical science course provides a broad range of health problems and issues (e.g., trauma and lung disease) appropriate for mathematical applications. The mathematics course reciprocates by equipping students with the mathematical skills essential to success in the science course. The most obvious interdisciplinary contributions of the mathematics course are to the science course, whereas ties such as in chi square between the mathematics course and the social science course are more subtle.

BIOMEDICAL SCIENCE

In the science curriculum, human anatomy and physiology provide a framework of physiological systems which tie the course together (see Table IV). Although the unit titles appear to be exclusively physiological, the actual content is far more comprehensive. In each unit, the health and medical aspects of a topic are given extensive consideration with appropriate treatment of related

chemical and physical concepts. Through the extensive use of activities, emphasis is placed on learning-by-doing. The theoretical concepts of many disciplines are applied in laboratory exercises that touch upon the prevention and treatment of personal and community health problems. Many of these exercises simulate the work of certain health professionals.

TABLE III

UNIT TITLES AND COURSE CONTENT
OF BIOMEDICAL SCIENCE

Unit	Unit Title	Course Content
YEAR ONE		
I	Respiration in Health and Medicine	Anatomy, physiology and pathology of the respiratory system; the behavior of gases; introductory chemistry; air pollution.
II	Nutrition in Health and Medicine	Anatomy, physiology and pathology of the digestive system; chemistry and biochemistry of foods; dietary deficiencies; energy storage and utilization; the optimal diet; dental health and disease.
III	The Transport System	Anatomy, physiology and pathology of the circulatory and excretory systems; the blood vessels, the blood, and the immune system; some fundamentals of electricity.
YEAR TWO		
IV	Sensory Systems	Anatomy, physiology and pathology of the sensory systems; introduction to the physics of sound and light; introduction to computer activities.
V	1. The Central Nervous System	Anatomy, physiology and pathology of the central nervous system; more computer science.
	2. Pharmacology	Selection and application of drugs; habituation and addiction; placebo effect.
VI	Trauma and the Musculoskeletal System	Anatomy, physiology and pathology of the musculoskeletal system; Newtonian physics as related to accidents and trauma; effect of trauma on the musculoskeletal system.
VII	Reproduction and Genetics	Anatomy, physiology and pathology of the reproductive system; cell division; gestation; birth defects; regulation of family size; venereal disease; human genetics; molecular biology; natural selection; populations.
VIII	Patterns of Disease and Ways of Life	Investigation of selected health topics by career interests with broad interdisciplinary applications.

TABLE IV

PERCENT OF SUBJECT CONTENT
IN BIOMEDICAL SCIENCE

Subject	Percent
Anatomy and physiology	20%
Laboratory medicine	14%
Physics	12%
General chemistry	11%
Biochemistry	10%
Clinical medicine	10%
General organic chemistry	7%
Computer science	6%
General biology	5%
Miscellaneous	5%

BIOMEDICAL SOCIAL SCIENCE

The biomedical social science course emphasizes process over content and inquiry in place of didactic instruction. Students are taught a variety of concepts and skills drawn from several of the social sciences that are particularly useful in dealing with the social, psychological and humanistic implications of relevant health problems and issues.

TABLE V

UNIT TITLES AND COURSE CONTENT
OF BIOMEDICAL SOCIAL SCIENCE

Unit	Unit Title	Course Content
YEAR ONE		
I	Health and Society: Basic Social Science Inquiry into Health-Related Problems	Dimensions of health; levels of analysis; points of view; methods of inquiry.
II	Health, Culture and Environment	Ethnocentrism; cross-cultural analyses; culture and nutrition; culture and health.
III	Decision-Making in American Society	Generalizing about societies; political decision-making; economic decision-making; formal and informal organizations; goal conflicts and decision-making; societal models related to health.
YEAR TWO		
IV	What Affects Human Behavior?	Value clarification; attitude formation; drugs and drug uses; small groups; social norms.
V	Allocation of Health Resources	Societal institutions; health-care systems and the individual; alternative health-care systems; political and economic dimensions of rescurce allocation.

TABLE V (continued)

Unit	Unit Title	Course Content
VI	Intellectual Development	Cognitive growth and moral development.
VII	Population Growth and Genetics	National and global perspectives on population growth; factors influencing population growth; genetic engineering; genetic counseling.
VIII	The Future of Health-Care Delivery	Epidemiology; social consequences of developments in health-care delivery; citizen participation in affecting health-care delivery.

Political science and sociology are the fields of study that contribute the greatest amount of content to the social science course (see Table VI). The curriculum focuses on current health problems (e.g., coronary heart disease, malnutrition and drug abuse) which require for their solution an understanding of the individual and his relationship to the social milieu in addition to basic science. Among the many problem-solving resources provided, students are taught the fundamentals of research methodology (sampling, questionnaire construction, participant observation and reporting), political efficacy (identifying problem areas and applying proposed actions), and value clarification.

In short, the social science course presents a large body of knowledge that is essential to health professionals and community decision-makers in the prevention and treatment of disease.

TABLE VI

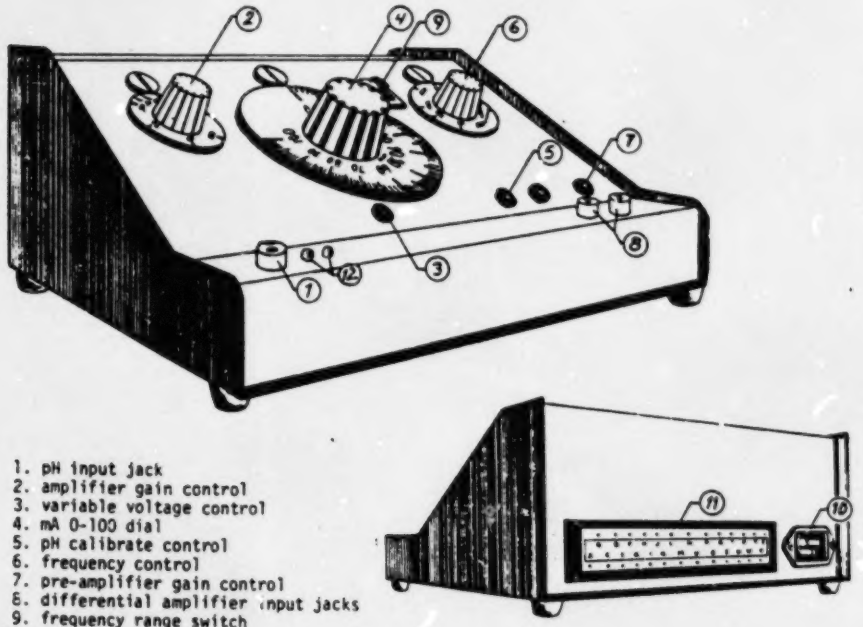
PERCENT OF SUBJECT CONTENT IN BIOMEDICAL SOCIAL SCIENCE

Subject	Percent
Political science	20%
Sociology	20%
Anthropology	15%
Economics	15%
Methodology	10%
Social psychology	10%
Epistemology	5%
Psychology	5%

In each of the three courses, students are confronted with health-related problems that require interdisciplinary solutions. These interdisciplinary learning experiences should prove invaluable to students as members of a rapidly changing society and as future health-care professionals.

THE BIOMEDICAL INSTRUMENTATION PACKAGE (BIP)

The BIP is an integral part of the Biomedical Curriculum. It is a low-cost, versatile, rugged electronic device developed to provide a wide range of laboratory measurements relevant to understanding sound, electricity and bioelectric phenomena. Also, it is used to perform such measurements as current, voltage, resistance, temperature and pH. Among the BIP applications are electrocardiography, electroencephalography, colorimetry, turbidimetry, sine waves, square waves, hearing testing, electrophoresis, electroplating and computer science. The BIP has made it possible to implement laboratory sequences heretofore not possible in most high schools.



1. pH input jack
2. amplifier gain control
3. variable voltage control
4. mA 0-100 dial
5. pH calibrate control
6. frequency control
7. pre-amplifier gain control
8. differential amplifier input jacks
9. frequency range switch
10. line cord socket
11. programming panel
12. diode lights

THE BIP

THE COMPUTER COMPONENT

The advent of large-scale integrated circuit technology (LSI) has resulted in a computer revolution. It is expected that microcomputers will soon be everywhere: in the home to control a security system, in the automobile to optimize engine performance, in industry to improve quality control, in restaurants to improve food preparation, and in the physician's office to aid in the prevention and treatment of disease, for example. This extension of the computer into our daily lives will make understanding it an important part of a general education.

The breadboard computer has been developed to provide a visual and hands-on experience in learning the fundamentals of computer science. It will provide for varying student interests and skills and create a friendly situation between the student and the computer. Simple concepts can be presented and understood. Challenging applications such as games and problem solving can also be programmed.

on the breadboard. Finally, the breadboard will allow students (and teachers) to discover that computers can be fun as well as useful.

GENERAL DESCRIPTION The BICP computer consists of 5 x 7.5 cm component cards which are easily attached to a frame by two nuts. Interconnections between components (programming) are made using 24-gauge solid wire with insulation removed from both ends. The bare wire is pushed into a terminal to make a secure electrical connection. With care, several hundred insertions and removals can be made without replacement of the terminal.

A complete computer set consists of the following:

LOGIC

8 2-input NAND
4 4-input NAND
1 8-input NAND
4 2-input AND
18 INVERT
4 2-input OR
4 2-input NOR

COUNTING

6 JK flip flops

CLOCK/TIMING

1 555 timer

INPUT MEANS

1 8-bit truth table
1 2-bit pulser

OUTPUT MEANS: every component card, except the truth table and timer, has an indicating light-emitting diode (LED) for each output. The diode is "on" for logical "1" and "off" for logical "0".

COMPUTER FRAME: consists of a 22 x 25 cm tempered masonite board with provisions for attaching up to twelve component cards. The card is electrically connected when it is installed.

The computer is first introduced early in the second year of the Biomedical Curriculum. An introduction to computer science is the first sequence followed later by applications in medical diagnosis, routing of health care, and taxonomy of racial characteristics.

THE BIOMEDICAL PRACTICUM

A major goal of the Biomedical Curriculum is to acquaint students with a variety of health careers. In addition to the regular curriculum, a Biomedical Summer Practicum has been designed to provide a learning-by-doing introduction to a variety of health careers and health-care settings. Students apply skills

acquired in the classroom and laboratory to actual work tasks within career situations. From these experiences, the intellectual and emotional demands of a particular health career become apparent to the students.

They spend five weeks on the job with health-care practitioners and two weeks in orientation and follow-up activities. One week is devoted to each of three student-selected health careers and two weeks to the career of greatest interest to them. A daily journal of work experiences is maintained by all practicum students. The journal entries are important sources of discussion during weekly group meetings.

For each of their career trials, students receive training requirements, working conditions, salary ranges and job descriptions. Students are assigned to a health practitioner who acts as their supervisor-teacher while the biomedical teacher assumes the role of "roving facilitator," through weekly career site visits and group discussions.

For those educators interested in offering a Biomedical Summer Practicum in conjunction with the curriculum package, a Practicum Guidebook is available.

THE BIOMEDICAL TEACHING TEAM

The interdisciplinary teaching team is the most vital organ of the biomedical program. Optimal teamwork requires communication, cooperation and coordination among teachers with necessarily different personalities, philosophies and backgrounds. Such a mix appears to be essential to achieving the interdisciplinary goals of the curriculum.

The following guidelines may prove helpful in establishing and maintaining the teamwork required to meet the goals of the Biomedical Curriculum.

- adopt a functional team definition of interdisciplinary education.

  The extent to which the three biomedical courses interrelate depends on the team's definition of interdisciplinary education and the degree to which the biomedical teachers are able to apply that definition to the learning experiences of their students.

- accept the need for diversity among biomedical teachers and students.

  Such acceptance may require members of the teaching team to "agree to disagree."

- establish and consistently apply policies and procedures for team decision-making.

  A decision-making model requiring open communication appears to obtain the best results among biomedical teaching teams.

- hold regular team meetings.

  A common preparation period is often the most appropriate meeting arrangement.

- adopt a role of "teacher-facilitator" to support the applied activity style of instruction inherent in the curriculum.

  Biomedical teachers should be prepared to assume a nondidactic style of teaching that places more responsibility for learning on the student through active participation.

THE BIOMEDICAL TEACHER

The one characteristic of biomedical teachers that appears to be prerequisite to a successful implementation is "a strong commitment to the Biomedical Curriculum." Beyond this common thread that should run throughout the biomedical teaching team, no other personal characteristics appear to be absolutely essential. Nevertheless, certain common features among biomedical teachers appear to contribute to a successful implementation of the curriculum.

The following general and specific guidelines may be helpful in selecting the biomedical teaching team.

In general, a biomedical teacher should

- be able to make a two-year commitment to the biomedical program.
- be interested in health.
- be able to apply a "student-as-teacher" style of instruction when appropriate.
- be able to establish a working relationship with other biomedical teachers with dissimilar personalities and ideals.
- be able to abide by decisions of the teaching team.
- be able to attend regular meetings of the biomedical teaching team.
- be interested in working closely with the counselors and parents of biomedical students.
- assume the responsibility for familiarizing themselves with the content of the other two biomedical courses.

Since half of the students' time throughout the entire Biomedical Curriculum is spent in the science course, a large share of a successful implementation effort depends on selecting the right biomedical science teacher. In general, the BIOMEDICAL SCIENCE TEACHER should

- have an academic backgound conducive to teaching biomedical science (e.g., a biology or physiology major and a chemistry minor or a chemistry major and biology or physiology minor).
- be willing to assume responsibility for the necessary preparations for all activities.
- have a minimum of extracurricular responsibilities, particularly during the first semester of biomedical science.
- have an activity-oriented teaching style.

The BIOMEDICAL MATHEMATICS TEACHER should

- have an academic background conducive to teaching biomedical mathematics (e.g., a math major and a biology, chemistry or physics minor).
- be particularly interested in teaching applied mathematics.

- be committed to coordinating the teaching of certain interrelated math and science lessons.

The BIOMEDICAL SOCIAL SCIENCE TEACHER should

- have a broad interdisciplinary social science background conducive to teaching biomedical social science (e.g., a sociology or anthropology major and a political science, economics, psychology, or general social science minor).

- be skilled in inquiry teaching.

THE BIOMEDICAL STUDENT

The selection of biomedical students is second in importance only to obtaining suitable biomedical teachers. In recruiting biomedical students, the counselors and biomedical teachers should work closely together to enroll students who meet the selection criteria established by school personnel.

Experienced biomedical teachers and BICP staff agree that students entering the biomedical program should

- be interested in health.

- be able to make a two-year commitment to the biomedical program.

- have finished grade 10.

- have a reading level of grade 8 or higher as determined by the "Comprehensive Test of Basic Skills" (reading section) or a comparable instrument.

- have achieved a grade average equivalent to a C+ or higher in their previous overall high school performance.

- have completed one year of algebra with a grade equivalent to a C or higher.

The biomedical student selection criteria should be shared with all students prior to active recruiting. Also, an informational meeting should be held for all parents of prospective biomedical students before the students make a commitment to the program.

An existing class of biomedical students is one of the best resources for recruiting students for subsequent classes. Often the informal grapevine of communication within the school produces many candidates for subsequent classes. Additional suggestions for recruiting students include school bulletins and newspaper articles, daily public address announcements, a student health fair, biomedical displays and exhibits, a special biomedical program assembly, and special audiovisual presentations.

ADMINISTRATIVE GUIDELINES

Selecting a teaching team and recruitment of students are important administrative aspects of implementation. Three additional considerations are: (1) curriculum and budget approval, (2) course scheduling and logistics and (3) preservice and inservice training.

CURRICULUM AND BUDGET APPROVAL

In the adoption of any new curriculum, high school administrators are required to respond to the concerns of local educational decision-makers. The following responses to questions about the biomedical curriculum may be helpful in obtaining the necessary support for implementation.

Q: *What are the basic features of the Biomedical Curriculum?*

A: It is a two-year curriculum, designed for high school students, consisting of three interrelated courses in science, social science and mathematics. All three courses are focused on the unifying theme of health and medical problems. The science course occupies a two-period block of time, somewhat more than half of which is devoted to laboratory activities, while the mathematics and social science are one-period courses.

Q: *Why was such a program created?*

A: As far back as 1968, the Secretary of Labor pointed to serious shortages of manpower in the health field. The following year, a study of over a thousand hospitals indicated that overall these hospitals were six per cent short of having the manpower to provide optimum care of patients. Over 70 per cent of the needed additional manpower was budgeted. In other words, funds were immediately available to fill 70 per cent of the needed positions, but qualified applicants were unavailable. Projections at that time gave every indication that the health manpower shortage would grow over time.

Q: *I don't quite see what this has to do with high schools. Isn't this a problem for the colleges to solve?*

A: To a considerable extent, yes. But keep in mind that colleges are at least partially responsive to demands placed on them by the students. Course offerings in any particular area can be increased only if there are students available who wish to take the courses. This is one of the functions of the Biomedical Curriculum--to sensitize students to the possibility of a health career, to make them aware of the broad variety of careers available and to give them an educational foundation that will contribute to success in further education and in the careers themselves.

Q: *But if high schools throughout the country offered the program, wouldn't the health field soon become flooded with workers?*

A: The needs are much larger than most people realize. Health care is becoming one of the largest areas of employment in the nation. In 1970, there were 4.4 million workers in the health field. By 1980, this figure will be around 6.4 million. To look at it another way, there are 200,000 more health-care workers each year than there were the year before. And this figure does not take into account the number of new personnel needed each year to replace those who retire or leave the field for other reasons. Health care now accounts for almost eight per cent of the gross national product.

Q: *So the program is basically a vocational one?*

A: On the contrary, the curriculum does not train students for specific jobs. Instead, it provides a core of experiences which are fundamental to the entire range of health-related careers. And, equally important, these same experiences help prepare the student to make rational and informed decisions to maintain his own health, both on the personal level and on the level of the total community.

Q: *Still, it seems awfully early to ask a student to commit himself to a lifelong career at the end of the tenth grade. For example, look at how many college students change their majors.*

A: As just indicated, there is no commitment to a single career or even a narrow range of careers. Following high school graduation, the student will have options that range all the way from immediate on-the-job training and one- to two-year terminal programs at the community college level to advanced university degrees.

Q: *What if a student decides, after taking the curriculum, that he doesn't want to pursue a health career?*

A: The curriculum is sufficiently basic and broad that this should prevent no special problems. Obviously a major shift in area of interest may cost a student some time. For example, a Biomedical student who later decided to become a civil engineer would need to make up some courses.

Q: *What is the purpose of a mathematics course in a Biomedical curriculum?*

A: There are a number of reasons for this. First of all, medicine is basically an applied science, and the sciences have a mathematical foundation. There are many health careers that require some understanding and use of mathematics. Technology, for example, is becoming increasingly important in health-care delivery. In addition, large segments of the health-career system are in the process of becoming computerized or otherwise automated--a trend that will doubtless grow in the future. (For this reason, the science course includes a partial treatment of computer fundamentals.) Furthermore, a basic introduction to mathematical concepts and skills will help the future health-care worker to adapt to new roles as the health-care system evolves. Major changes in the system are expected over the next two decades. The Biomedical Curriculum should enable students to take full advantage of many of these changes.

Q: *How does the mathematics course differ from the traditional program?*

A: It covers most of the topics that are traditionally taught in eleventh-and twelfth-grade mathematics, although with a somewhat different emphasis. The primary difference is that the course is applied, rather than abstract. We mentioned earlier the interrelationship of the Biomedical courses. This relationship takes many forms. In some cases, data collected in the science course are analyzed and generalized in the mathematics course. Mathematical skills needed to solve problems in the science course are developed in advance in the mathematics course. Statistical techniques needed in both the social

science and science courses are first developed in the mathematics course. Even when there is no specific connection to the other courses, the mathematics concepts under development are applied to health and medical problems. A consistent response from students who have taken the course is that they came to understand and appreciate the value of mathematics in solving real problems. Many of them perceive mathematics as "relevant" for the first time in their educational careers.

Q: *What sort of special training is needed to teach the course?*

A: None, really. Anyone who has taught eleventh- and twelfth-grade mathematics should have little difficulty with our course. There are some areas that may be unfamiliar (e.g., propagation of error, dimensional algebra, symbolic logic, chi square), but the materials themselves provide sufficient information for their instruction.

Q: *What is the science course all about?*

A: Human physiological systems provide the basic framework that ties the course together over the two years. The health and medical aspects of each topic are given extensive treatment along with basic chemical and physical concepts wherever appropriate (e.g., the gas laws in connection with respiration or biochemistry in connection with nutrition and digestion). In very broad terms, the course is about 25% anatomy and physiology, 25% health and medicine, 30% chemistry and biochemistry, 10% physics and 5% computer science. Stress is placed on learning-by-doing through the extensive use of laboratory activities. The concepts of many areas of science are applied in laboratory exercises that touch upon personal and community health problems. Many of these activities parallel or simulate the work of various health professionals.

Q: *Teaching the science course appears to be quite a challenge. How can anyone be expected to be an expert in all those different fields?*

A: It is not quite as difficult as it sounds. Most biology teachers have significant experience in chemistry and biochemistry. Also, extensive background information is provided in the teacher materials on the health and medical aspects of the curriculum. But it is true that some pre-service or in-service training is very useful. We have found that a total of about 10 days of training is sufficient for most teachers to present the two-year course without significant difficulty. At the present time, we are experimenting with presentation of the curriculum with no special teacher training.

Q: *How does the social science course fit into the total picture?*

A: In recent decades there has been considerable concern expressed about the dehumanization of health care stemming, at least in part, from the increasing specialization of health professionals and the growth in medical technology. One of the functions of the social science course is to enable the student to see that illness and disease are human problems, as well as medical problems. In other words, the solution to medical problems involves not only science, but also society, government agencies, psychology, human values and economics.

The course presents the basic concepts of several social sciences (political science, sociology, economics, etc.); but, as with the mathematics course, the applications of the concepts are strongly oriented toward health and medicine and health-care delivery systems.

Q: *Is special training needed to teach this course:*

A: Not really. The teacher should be familiar with inquiry approaches to social science instruction and have a social science background.

Q: *What is the overall effect of the curriculum as a whole?*

A: When the three teachers work and plan together as a team, each course serves to motivate and support the other two. Our experience thus far indicates that biomedical students are better motivated than most students in general. Part of the reason for this is the "school-within-a-school" that emerges as the same students work together for four classroom periods a day. But more important is the fact that the information and skills learned are relevant in the eyes of the student, because they have both personal and career applications that are made continuously apparent.

Q: *How many students have taken the program so far?*

A: About 140 students in six California high schools completed the initial two-year trial of the program in June 1975. Another 450 students in 15 high schools have begun the program (September 1975). By the fall of 1976, it is expected that from 75 to 100 biomedical classes will be in operation in several regions of the country.

Q: *What is the first group of students doing now?*

A: Almost all of them (85 per cent) are enrolled in various colleges and universities. The majority are attending local community colleges, but a significant number applied to and were accepted by major universities such as Stanford University, Yale University and University of California, Berkeley. The curriculum is considered to be academically equivalent to most precollege curricula.

Q: *How much does it cost to start up a biomedical class?*

A: The cost of implementing the Biomedical Curriculum is approximately $2,000 for the first year and $1,600 for the second year of the program (see Table VII, Implementation Costs). Reduction in district cost can be achieved through centralized purchasing and sharing of materials, modification of certain laboratory activities and the acquisition of outside funding.

Q: *Isn't that rather expensive?*

A: It would be, if you had one two-year class and then discontinued the program. However, we estimate the cost of implementing and maintaining the biomedical course for 30 students over a six-year period to be about $800 per year, which

is a cost of $27 per student year. Keep in mind that this figure covers four periods of instruction per student. By using one entire curriculum package for two biomedical classes, the cost can be further reduced to approximately $16 per student year over a six-year period.

TABLE VII

IMPLEMENTATION COSTS

Item	Unit Cost	Quantity	Total Start-Up Cost Per Year for First Year	Second Year	Total Maintenance Cost/Year for Third Year
BIP	$80	7-10	$560-800		0
Computer Components	50	7-10	0	$350-500	0
Laboratory Supplies			400-500	250	$250
Textbooks			990	990	0
Worksheets			0	0	50
		TOTALS	$1,950-2290	$1,540-1740	$300

COURSE SCHEDULING

The various patterns under which high schools function have resulted in several different designs of implementation of the Biomedical Curriculum. Although each school presents a unique setting, several recommendations have emerged from the experiences of school personnel who have implemented the curriculum.

Assuming the entire curriculum package is being adopted, the science and mathematics components should be taught sequentially during the morning. The general consensus is that the one-hour biomedical mathematics class should meet prior to the two-hour biomedical science class. The one-hour biomedical social science class could then meet in the early afternoon. When the mathematics and science classes meet sequentially, there is the option of sharing class time, when deemed appropriate, to better coordinate interrelated lessons. Variations of this somewhat arbitrary theme may be necessary to conform to school specific instructional and scheduling patterns. Depending on the teachers involved and the class scheduling scheme, a team-teaching arrangement for the mathematics and science classes is another possible alternative.

Given the various alternatives that exist within a specific school, the biomedical teaching team and their administrator can best determine the most desirable arrangement of scheduling the curriculum. Additional courses, required or elective, in which biomedical students are enrolled may also be an important scheduling factor.

PRE-SERVICE AND INSERVICE TRAINING

Although successful implementations of the Biomedical Curriculum have been accomplished in the absence of any pre-service and inservice training, some project assistance is advisable. Curriculum content in most cases should not pose any problems for qualified teachers. However, the activity-oriented teaching process inherent in the science and social science curricula may require some preliminary pre-service training in those school districts without experienced biomedical teachers who could provide assistance.

Two to three days of pre-service training appears to be adequate for a successful implementation of the curriculum. The project is prepared to provide such pre-service training. Also, on-site inservice assistance will be provided upon the request of a biomedical teaching team, subject to project staff commitments.

The topic of paramount importance in pre-service training is the development of the biomedical teaching team. Other important topics covered are (1) a hands-on introduction to the Biomedical Instrumentation Package (BIP) and the computer component, (2) teaching resources, and (3) the biomedical practicum. Project-sponsored pre-service training sessions will involve experienced biomedical teachers who can answer specific questions about the curriculum from the vantage point of having taught it. Inservice sessions, when held, usually focus on imporving interdisciplinary teamwork and covering specific content and activities which may be problematic for some teachers.

Project staff are always available to respond to any inquiries from biomedical teachers and their administrators.